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Federal Highway Administration
United States Department of Transportation
1200 New Jersey Ave. SE
Washington, DC 20590

RE: Request for Information on the J3400 Connector and Potential Options for Performance Based Charging Standards Docket No. FHWA-2023-0054

Dear Administrator Bhat:

The Charging Interface Initiative (CharIN) is the largest global association focused on the electrification of all forms of transportation based on the seamless and interoperable charging experience enabled by the Combined Charging System (CCS) and the Megawatt Charging System (MCS). CCS and MCS are the global standards for charging vehicles of all kinds. An inclusive, industrywide coalition, CharIN represents nearly 300 leading e-mobility stakeholders, from automakers to utilities, grid operators, component suppliers, and charging station developers. Nearly 75 of these members are based in North America. A complete list of members may be found on our website at www.charin.global.

CharIN appreciates the opportunity to provide comments to the Federal Highway Administration's (FHWA) Request for Information on the North American Charging Standard (IS) J3400 Connector and Potential Options for Performance-Based Charging Standards. CharIN believes that minimum technical standards for EV charging infrastructure under the National Electric Vehicle Infrastructure (NEVI) program should be complementary to current market trends and support the rapidly evolving EV landscape. They should also be informed by evolving market context and data to allow flexibility for the charging industry to determine which charging connector standards are most appropriate for a particular charging use case. Enabling flexibility will not only drive investment efficiency but also future proof connector standards to meet EV driver needs. Utilization is a key determinant for the cost effectiveness of charging infrastructure investment. Therefore, charging providers are best suited to determining which connector type, whether CCS or J3400 or some combination thereof, is most appropriate for infrastructure deployment depending on location, use case, utilization, and other factors.

In response to the questions below, CharIN highlights the need to create a flexible, future proofed standard that enables serving both CCS and J3400 vehicles while enabling the underlying minimum standard to be technology neutral in line with the intent of the Bipartisan Infrastructure Law.

1. **Market Availability**

It is CharIN's understanding that J3400 is currently moving from the published technical information report (TIR) to the recommended practice (RP) phase. CharIN recommends that FWHA continue to keep a pulse on the development of J3400 as it nears completion. This includes understanding the technical nuances of the underlying communication protocols related to ISO 15118 and other specifications.

b. What safety standards will J3400 EVSE products need to be certified to and when will that certification occur? Are there any concerns with obtaining appropriate electrical and mechanical safety certifications for the J3400 connector?

UL 2251 is required for J3400 charging guns then later electric vehicle supply equipment (EVSE) companies will certify DC UL 2202 and 2231 (AC UL 2594) the EVSE.

The current adapter certification that is in development is UL 2252 for a one-piece adapter. However, no product in the market today is certified under UL 2252 because the technical details of UL 2252 are still being ironed out. Several adapters currently in the market, including on major online retail sites, are advertising certifying standards that are not relevant to safety. CharIN is concerned that these non OEM provided and non-certified adapters will pose a safety risk to consumers.

d. Will future 800V vehicles be backwards compatible with 400V charging stations? If yes, for how long?

Backwards compatibility is dependent on EV OEM vehicle design choices. This is not specific to a connector type.

e. What, if any, opportunities do you see to commercial availability and use of J3400 connectors and chargers?

Outside the discussion of utilizing J3400 as part of the initial NEVI highway corridor fast charging program deployments, there are additional opportunities that can be provided. For school districts and fleets the extension to 277V for level 2 allows installations without added transformers. Additionally, AC/DC pin sharing may allow EVs to potentially charge on both L2 and Fast chargers interchangeably.

f. What, if any, barriers do you see to commercial availability and use of J3400 connectors and chargers?

An important part of the discussions in the J3400 SAE process is to ensure that AC/DC pin sharing is well documented and executed on. This is a key priority for the working group.

2. Technical Compatibility w/23 CFR Part 680

In general, CharIN does not foresee any challenges with J3400 meeting the requirements in 23 CFR Part 680. CharIN believes it will be important to ensure UL safety standards are met. At the same time, in the AC charging space, it will be important to understand the impact of 277V charging applications.

a. Do you foresee any challenges with J3400 specifically meeting the power delivery requirements in 23 CFR 680.106(d)? Please elaborate on these challenges with specific examples, data, etc.

No. It is important to note however that at low voltage levels such as 250V in order to obtain 150kW power level, higher current at 600A is required. Products today, however, are not currently certified.

b. Do you foresee any challenges with J3400 specifically meeting the interoperability requirements in 23 CFR 680.108? Are there any challenges with J3400 meeting other aspects of interoperability, including

compatibility, safety, and performance of connectors/inlets/adapters, communications or security protocols, or support of vehicles designed to charge using CCS/J1772 connectors? Please elaborate on these challenges with specific examples, data, etc.

No. As discussed further below, however, it is important to evaluate 277V charging capability provided by J3400 for AC installations. There may be some short-term compatibility challenges for 277V nominal in some existing vehicles that are not compatible. Additionally, adapters are an important topic to monitor.

c. Do you foresee any other challenges with J3400 meeting other existing requirements in 23 CFR part 680? Please elaborate on these challenges with specific examples, data, etc.

No. It is, however, important to monitor any response time to proximity out-of-range requirements modifications which may trigger hardware modifications for some existing EVSE.

3. Implementation Challenges and Benefits at Charging Stations

a. Is there a need to include J3400 connectors on all federally-funded chargers? Is there a difference between the use of J3400 connectors for DCFC or AC Level 2 charging?

As discussed further in the performance-based standards section, CharIN supports taking a connector technology agnostic approach as long as operators are using either CCS1 or J3400. Requiring that connectors utilized are certified to the Society of Automotive Engineer (SAE) standards and applicable UL certifications is appropriate. Additionally, connectors should be non-proprietary and serve more than one-vehicle type per the underlying IIJA. Enabling connector flexibility not only allows manufacturers and operators to meet market demands but also enables a transition across time between CCS1 and J3400 vehicles in the next several years. Finally, requiring dual connectors at every stall could lead to additional challenges because it could decrease charger reliability as cables and connectors are often the components subject to the highest levels of wear and tear and damage. Enabling a one port/connector per stall scenario is important.

b. Is it practical to retrofit an existing DCFC with a J3400 or other connector either in addition or as a replacement to an existing connector? What is the cost of installation to retrofit an existing charger with a J3400 or other connector in addition or as a replacement to an existing connector? Would retrofitted or added J3400 connectors on DCFC ports suffer from performance loss relative to natively installed CCS connectors? Are there other challenges with retrofitting an existing charger? If so, please describe challenges.

While it does seem practical to retrofit the current CCS EVSE infrastructure, there are some extra costs beyond the charging cable itself that must be evaluated. The benefits of retrofitting existing CCS1 EVSE outweigh using adapters due to inherent safety risk of non-certified adapters (see comments above) and worse performance results. Several items under consideration for updating existing CCS infrastructure include:

- Proximity derating scheme is not yet settled but is different;
- Communication messages would need to be updated;
- OCCP back office treats it as a different connector;
- HMI screens often have illustrations so they would need to be updated;
- App software update;
- EVSE visual signs would need to be updated;
- EVSE holster will need to be updated; and
- 10ms response time to loss of proximity will require hardware update.

g. Are there any compatibility, reliability, or safety concerns about charging vehicles that are designed to charge using CCS/J1772 connectors at new J3400 AC level 2 chargers or at J3400 DCFCs with an adapter?

Adapters will need to meet all safety, isolation, and increased robustness requirements compared to a cable assembly, which is covered under UL 2251.

CharIN recently released a statement on adapter safety. In this statement, CharIN recommended the following interim steps by OEM EV manufacturers, federal and state regulatory agencies, and charge point operators (CPO) regarding the use of adapters:

- EV OEMs notify their dealers and vehicle owners that the use of any adapter other than the respective EV OEM's approved adapter (e.g. any aftermarket, or will-fit, adapters) may result in severe damage to their vehicle and cause damages to the EV charging infrastructure and surrounding facilities;
- National Highway Traffic Safety Administration (NHTSA)/Federal Motor Vehicle Safety Standards (FMVSS) and the Consumer Product Safety Commission (CPSC) engage to restrict market access to non-OEM approved adapters; and
- Charge Point Operators (CPOs) provide only EV OEM approved adapters and provide messaging via their public communication channels in addition to signage on the EVSE dispenser regarding the use of adapters.

CharIN will continue to expedite its efforts to support the development of proper standards for EV charging couplers and charging systems with the aim that once these Standards are published and the EV infrastructure build-out expands that the use of adapters will be eliminated thereby mitigating the inherent risks. See also CharIN's View on Adaptors within the Combined Charging System (https://www.charin.global/media/pages/technology/knowledge-base/d5b6b3c40a-1615552587/charins_view_on_adaptors_within_the_combined_charging_system_v08.pdf) and CharIN's adapter statement at https://www.charin.global/news/charin-statement-regarding-sae-j3400-adapters/ (also in the APPENDIX).

AC Compatibility

- AC current vehicles might refuse to charge with J3400 if they work at 277V nominal.
- Currently (as of March 28), no AC adapters are UL2252 certified, therefore they have unknown performance.
- AC J1772 does not require a latch secured while charging and would create arcing disconnecting underload.

AC reliability

- Adapters that are not certified or provided by an OEM may damage current infrastructure resulting in EVSE downtime.
- Current AC vehicles might refuse to charge with J3400 EVSE that work at 277V nominal.

AC Safety

- If current AC EV that is not compatible with 277V charges at a J3400 EVSE, 277V might damage the on-board charger and could potentially create a thermal event.
- Using a DC adapter connected to an AC EVSE might cause safety hazards.

DC Compatibility

- Currently (as of March 28), no DC adapters are UL2252 certified, therefore they have unknown performance. Also, most of them use 500V geometry and unknown current capability ratings.

DC Reliability

- Adapters that are not certified or provided by an OEM may damage current infrastructure resulting in EVSE downtime.

DC Safety

- Currently (as of March 28), no DC adapters are UL2252 certified, therefore they might expose the user to safety risks.
- Also, most of them use 500V geometry that is not in the J3400 standard generating a safety risk on a 1000V charging session. Unknown current capability ratings could also create thermal events.
- Using an AC adapter connected to a DC EVSE might cause safety hazards.
- Adapter safety concerns have been discussed in earlier sections with reference to the CharIN Statement on Adapters.

h. What are the challenges, if any, in ensuring that J3400 will utilize ISO15118 cyber physical security protections such as TLS authorization and authentication?

CharIN recommends FHWA review the TIR and the RP for detailed information on the provisions related to communications protocols and any associated cybersecurity protections. J3400 is focused on the form factor of the connector but the RP includes recommendations on critical communication elements. These are the same as key communication elements for CCS1. In particular, using ISO 15118 cyber security features on a J3400 interface exhibits no other challenges than using ISO 15118 cyber security features on a CCS/J1772 interface.

5. Performance-Based Standards

CharIN appreciates the consideration of a performance-based standard for evaluating connector types as part of the federal minimum standards for NEVI. Generally, performance-based standards are an efficient mechanism for enabling the market to play a role in determining which technology is appropriate while setting key targets and objectives for desired outcomes, no matter what technology design is utilized. To ensure that charging infrastructure deployed in 2025 and beyond, that will be impacted by any alterations in the underlying federal minimum standards, is serving existing and new vehicles, we believe that the minimum standard should be updated to enable both CCS1 and J3400 connectors to participate in the program. This would include removing the requirement for CCS only and instead enabling charging operators to deploy whichever connector type is most appropriate to satisfy EV drivers in a particular location and for a particular use case.

a. If there is a need to include J3400 connectors on chargers, what are the advantages and disadvantages of the following design-based approaches?

Approach 1: Include both J3400 and CCS Type 1/J1772 connectors on each port.

Approach 2: Include a specified number of each type of connector (J3400 and CCS Type 1/J1772) at each charging station. Under Approach 2, what is the optimal ratio of J3400 connectors to CCS/J1772 connectors? Why?

Including both J3400 and CCSType1/J1772 connectors on each port is not an optimal approach as it would increase costs, not all ports have dual cable capability and lead to a scenario where in the near term, the minimum standards would need to be updated as new vehicle models and EV adoption increase. Additionally, if each AC port were required to support both J1772 and J3400, the opportunity to save installation cost by avoiding step down transformer may be mitigated. This may also increase charging time since the voltage advantage would not be optimized.

At the same time, picking a connector ratio today that may not hold true over time is risky at best. The market should help determine optimal ratios for connectors. The ratio of J3400 chargers to CCS/J1772 chargers should match the forecasted ratio of J3400 vehicles to CCS/J1772 vehicles, taking into account equity (e.g., used vehicles), disadvantaged communities, rural, and intra- and inter-state travel. The charging market is best set up to make this determination given ratios may also change over time.

If there is not a need to include J3400 connectors on chargers, what are the advantages and disadvantages of the following design-based approaches to including J3400, CCS/J1772, or other connectors alongside cables?

Approach 1: Provide at least one adapter for J3400 connectors at each charging station.

Approach 2: Customers must provide their own adapters for use.

Are there alternative design-based approaches to accommodate J3400 and CCS/J1772 equipped vehicles?

In the comments above, CharIN highlights its adapter safety statement which would be applicable in the context of the adapter discussion for each charging station. Generally, the use of adapters should be a short-term temporary solution and native charging cables are preferrable to ensure safety and reliability of EV charging stations.

b. Are there performance-based alternatives to specifying charging standards and communication standards (such as J3400, J1772, or ISO 15118) by reference that would support a convenient, affordable, reliable, and equitable EV charging network while reducing the need for future refinement to federal regulations?

The federal minimum standards already include a number of performance-based measures including uptime, availability, and safety. The standards referenced in this question are not necessarily tied to performance. In the future, given the work of the ChargeX consortium on charging KPIs, the minimum standards may need to be re-evaluated to include some of these indicators once they have been proven in the field and more information has been gathered. This is separate from a connector standard discussion.

d. Should performance-based standards include requirements for achieving Key Performance Indicators most important to EV customers? If so, what should those Key Performance Indicators be?

CharIN is currently participating in the ChargeX consortium which is evaluating key KPIs. We encourage this work to continue prior to making any modifications to the minimum standards.

6. Other Considerations

a. Is there anything additionally that should be considered related to EV charging connector standards and technologies that is not covered in the above questions?

CharIN encourages FHWA to also evaluate the need for medium- and heavy-duty vehicles under the minimum standards. MCS J3271 is imminent and could be considered to enable EV Truck and bus fleet adoption. In the future, wireless EV charging should also be considered for some segments.

Conclusion

CharIN appreciates the opportunity to provide feedback to FHWA regarding the J3400 standard and integration into the federal minimum standards. Generally, CharIN supports an approach that ensures connector flexibility enabling both CCS and J3400 to be deployed while maintaining certification and safety standards with SAE and UL. The market is in the best position to determine an appropriate ratio of CCS to J3400 deployments, and minimum standards should continue to serve as a guidepost.

Sincerely,

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APPENDIX: CharIN Statement Regarding SAE J3400™/SAE J1772™ Adapters

[WASHINGTON, D.C., November 28, 2023] --- In its efforts to advance the safe and reliable EV charging experience for the global EV market, the Charging Interface Initiative Inc. (CharIN) and its members have led the way with charging system development, industry interoperability testing and public education. CharIN has consistently advocated for the Combined Charging System (CCS), consisting of both AC and DC charging, including the new Megawatt Charging System (MCS), as the most versatile charging coupler interfaces with worldwide adoption.

With the announcements beginning in May 2023 by vehicle Original Equipment Manufacturers (OEMs) stating their intentions to access the Tesla charging network and implement the Tesla North America Charging Standard (NACS), CharIN launched a series of activities focused on developing best practices and critical specification recommendations to aid industry Standard Development Organizations (SDO), specifically the SAE document, SAE J3400™, and UL document, UL2251. While the topology and communications protocols between the CCS and the NACS charging systems are similar, the charging coupler interfaces are not interchangeable. As such, the use of an adapter has been recent practice and is expected to increase in popularity.

CharIN has advocated for the use of a complementary, native charging connector that matches the EV charge port in order to avoid the need for an adapter[(1)]. Nevertheless, CharIN expects that the use of adapters will increase until the time that SDO certified, SAE J3400™ compliant charging connectors are widely installed for public use.

Additionally, there are no SDO published standards for adapters. Many available adapters lack proper safety features and pose considerable public safety risks of potential electrical shock and/or fire hazards. While Underwriters Laboratories (UL) has issued an outline document[(2)] for such adapters, the review and consensus standards publication process is not expected to be completed until mid-2024.

Accordingly, and based upon documented evidence from multiple catastrophic charging event failures involving charge coupler adapters, CharIN recommends the following interim steps by OEM EV manufacturers, federal and state regulatory agencies, and charge point operators (CPO) regarding these adapters:

- EV OEMs notify their dealers and vehicle owners that the use of any adapter other than the respective EV OEM's approved adapter (e.g. any aftermarket, or will-fit, adapters) may result in severe damage to their vehicle and cause damages to the EV charging infrastructure and surrounding facilities;
- National Highway Traffic Safety Administration (NHTSA)/Federal Motor Vehicle Safety Standards (FMVSS) and the Consumer Product Safety Commission (CPSC) engage to restrict market access to non-OEM approved adapters;
- Charge Point Operators (CPOs) provide only EV OEM approved adapters and provide messaging via their public communication channels in addition to signage on the EVSE dispenser regarding the use of adapters.

CharIN will continue to expedite its efforts to support the development of proper standards for EV charging couplers and charging systems with the aim that once these Standards are published and the EV infrastructure build-out expands that the use of adapters will be eliminated thereby mitigating the inherent risks.

References:

1) CharIN's View on Adaptors within the Combined Charging System, 2019-04-16, https://www.charin.global/media/pages/technology/knowledge-base/d5b6b3c40a-1615552587/charins_view_on_adaptors_within_the_combined_charging_system_v08.pdf

2) UL 2252 – Outline of Investigation for Adapters for use with Electric Vehicle Couplers, Issue Number 1, Underwriters Laboratory, July 28, 2023 (within the Technical Committee of UL2251), https://shopulstandards.com/ProductDetail.aspx?productId=UL2252_1_O_20230728